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bell stroke, and the time was taken with the chronoscope. The explanation of these results requires no more than an extension, to those cases where there are no aids to concentration, of the idea that concentrated attention can voluntarily set up a brain-reflex; and Sergi seems to have been the first to suggest that idea. His results stand, however, so directly in opposition to previous results that skepticism is natural. It may be asked, for example, whether the starting of the chronoscope itself did not act as a signal; and some chronographs also run slower for as much as three-quarters of a second after the throwing in of the hands (see C. S. Peirce, U. S. Coast Survey Reports for 1870, Appendix 21, p. 212). The subject is one worth further investigation. Wundt strangely seems not to have known of this paper when preparing the new edition of his psychology. E. C. S.

Recherches expérimentales sur la durée des actes psychiques les plus simples et sur la vitesse des courants nerveux à l'état normal et à l'état pathologique. A. RÉMOND. Paris: Octave Doin. 1888, pp. 135.

The author of this thick pamphlet has made 30,000 observations in all, on students, soldiers, old people, hemiplegics, and those suffering from myelitis, general paresis, epilepsy, hallucinations, delusions, hysteria, and muscular atrophy. He has plenty of "results" too, but unfortunately not of the decisive and convincing kind that might be hoped. The apparatus used was poor; the chronoscope (*chronomètre de d'Arsonval*) must have been far inferior to the Hipp instrument, and the other arrangements, if fully described, were not up to modern requirements. The tables, though numerous, show only the maxima, minima and averages of the series, and not the average variations. The stimulus was tactile; a certain portion of the hand, shoulder, ankle and hip were touched with a ball, a conical point and a needle. Discrimination-times were measured by using the ball and point in irregular order and requiring reaction to only one. The general conclusions reached are given for what they are worth. (1) The approximate speed of transmission in the sensory nerves in normal subjects is about 34.72 m. per sec. in the legs and 27.02 m. in the arms (determined by Schelske's method, *i. e.* by comparing reaction times for stimulated points unequally distant from the brain). The rate seemed increased in those of the aged affected with general atheroma, in hemiplegics (on the diseased side when there was secondary contracture), and in delirium of persecution. In all other cases the rate was diminished. (2) Motor conduction in the cord and nerves is quicker than normal in flaccid hemiplegia and in the presence of a disturbing noise, about normal with the epileptics, and slower with the other subjects. (3) The discrimination-time, normally 0.063—0.070 sec., is longer with a disturbing noise and for all the invalid subjects except the epileptics (with whom it is shorter), the hemiplegics with contracture when stimulated on the sound side, and the simply aged, with whom it is normal. (4) The simple reaction-time, found in the normal to be 0.1545—0.1587 sec., is shorter after taking phenacetine or antipyrine, and in old age with general atheroma, hemiplegia (on the sound side; on the diseased side likewise with contractures), and in hysteria. (5) The reaction-time is regularly shorter for strong stimuli, except sometimes with the aged, hemiplegics, epileptics

and those with myelitis. (6) The psychic stage is the largest of those that make up the simple reaction-time, except with the epileptics, where it is exceeded by that of centrifugal conduction.

Mental Association investigated by Experiment. Prof. J. MCK. CATTELL and S. BRYANT, D. Sc. Mind, April, 1889.

These experiments touch the question at two points: the time required, and the relative frequency of the different kinds. Three methods were used: one in which a printed word was shown, the word suggested called out, and the time accurately measured with apparatus; another, in which lists of ten words were shown, the word suggested by each called out, and the time for one found from the time for all; and a third, in which a word was pronounced and the subjects wrote down the words successively occurring to them in 20 seconds. None of these measure the bare process of association, and the second and third take in other processes; still it is possible by them to reach relative results of some certainty and to gather interesting statistics. The first method, used by Cattell and Berger, gave average association times of about half a second. The second method was used by the experimenters on themselves with very many words, and, with fewer, on a number of other people, including university graduates, students in a ladies' college and in a German gymnasium. The times found vary from 1.14 to 7.07 secs., the first for Cattell himself with concrete nouns, the second for the youngest boys tested at the gymnasium and with abstract nouns. The third was applied chiefly with London and Dublin school-girls. The oldest and most advanced averaged one association in 4.13 seconds, the youngest one in 9.33. Of the twenty nouns used, the English girls gave the greatest number in 20 seconds for "ship" (4.8), the least for "virtue" (2.3). The different series show that the association time is longer for abstract than for concrete nouns, and that maturity and mental discipline tend to reduce this difference.

Of fresher interest are the statistics of frequency. The first table, based on the associations of 465 persons with 10 concrete and 10 abstract nouns, gives the associations occurring ten times or over. The table averages less than eight associations per word, and yet contains more than half of all given—an evidence of the general uniformity of mental action in different individuals. All the associations with the words "house" and "time" were classified after a scheme like Wundt's, and showed, among other things, that most of the associations of co-existence were visual, like "house" and "garden"; most of those of succession were verbal, like "house" and "house-top." Treating in the same way a mass of over 12,000 observations from 512 persons, school-girls predominating, it appears that concrete nouns owe their associations a little more frequently to connection in sensation than to logical connection; that to go from whole to part, or to specialize, is much commoner than to go from part to whole, or to generalize; also that it is easier to go forward ("house" to "house-top") than backward ("house" to "glass house"), and easier to go to final than to efficient causes. The associations of abstract nouns, except verbal associations, are rarely due to the senses; about two thirds of the cases were correlations and specializations. Classifying again for observers, it appeared that those that write and teach prefer logical and verbal associations; two teachers gave respectively 33 and 26 per cent of verbal associa-